TABLE OF CONTENTS

Checking and repair: W-001/505

Product: KB- starting motor

Part no.: 0 001 41. ...

Continue: I01/2

TABLE OF CONTENTS

Continue: I02/1

SPECIAL FEATURES

These instructions describe the repairing of starting motors of type KB 0 001 41..

- 12 V/3.5 kW
- 12 V/3.6 kW
- 12 V/4.0 kW
- 24 V/5.4 kW
- 24 V/6.6 kW

The multi-plate clutch can no longer be repaired. A damaged or worn clutch is always to be renewed as a complete unit.

Continue: I02/2

SPECIAL FEATURES

KB starting motors as of date of manufacture FD 461 feature the following quality enhancement:
The busbar term. 30 and stud term. 50 are insulated on the inside of the starting motors by way of thermoplast encapsulation. Starting motors prior to FD 461 with the old non-insulated version for terms. 30 and 50 must be converted to the new thermoplast-encapsulated version.

Continue: I03/1

SPECIAL FEATURES

The checking of oilproof and waterproof starting motors is treated in separate instructions.

Starting motors may be operated with the combined start-locking and start-repeating relay.

Continue: I03/2

SPECIAL FEATURES

The functions of the combined start-locking and start-repeating relay are as follows:

* Start-locking function (cutout in the event of motor self-start, prevention of starting-motor actuation with engine running and after interruption of start command until engine has stopped)

* Start-repeating function (automatic repetition of starting-motor actuation until pinion has engaged)

Continue : I01/1

STRUCTURE, USAGE

User prompting is provided on every page e.g.:
- Continue: I 17/1
- Continue: II 18/1 Fig.: II 17/2

Brief instructions may include several rows of coordinates.

```
  I../. = first coordinate row
 II../. = second coordinate row
III../. = third coordinate row
etc.
```

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: I01/1

GENERAL

Expert repairs can only be performed with the prescribed tools and properly functioning measuring instruments. We therefore recommend that exclusive use be made of the tools indicated.

The use of incorrect and unsuitable tools and testers may result in injury and could cause damage to the product and components.

Continue: I05/2

GENERAL

Make exclusive use of service parts as per the replacement parts list for the type of starting motor concerned.

To guarantee proper functioning, use must be made of the lubricants prescribed in these instructions before and during assembly.

Take care to ensure cleanliness when performing repair work.

Continue: I01/1

SAFETY PRECAUTIONS

Component cleaning:
Only use compressed air (max. 4 bar) and a clean rag to clean armatures, excitation windings, commutator end shields, relays and the shaft ends of the multi-plate clutch. Do not use cleaning fluids.

Other parts, such as intermediate bearings and drive-end bearings, can be washed out in commercially available cleaners which are not readily flammable.
Take care not to inhale vapors.

Continue: I06/2

SAFETY PRECAUTIONS

Danger of fire: Avoid naked flames, light and sparks.

ATTENTION:
Thoroughly dry cleaned components, as gases may subsequently form in the sealed starting motor and cause an explosion.

Always use tools indicated. The use of incorrect and unsuitable tools and testers could lead to injury.

Continue: I07/1

SAFETY PRECAUTIONS

Pay attention to the following safety regulations:

* Order governing work with flammable liquids (VbF) as issued by the German Ministry of Labor (BmA).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for handling chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  as issued by the Main Association for Professional Liability Insurance Associations (Central Association for Accident Prevention and Industrial Medicine), Langwartweg 103, 53129 Bonn.

Continue: I07/2

SAFETY PRECAUTIONS

Outside Germany, pay attention to the appropriate local regulations.

Skin protection:
To prevent skin irritation when working with oil and grease, apply hand cream before starting work and wash hands in soap and water afterwards.

Continue: I01/1

TESTERS, FIXTURES, TOOLS

Listed in the following are all the tools required for repairing starting motors of type KB.

Where tools used to be ordered by way of type designation, this is indicated in parentheses.

Continue: I08/2

TESTERS, FIXTURES, TOOLS

Interturn short circuit tester:	0 986 619 110
Test prods:	0 986 619 114
Alternator tester WPG 012.00: (or Motortester)	0 684 201 200
Magnetic instrument stand:	4 851 601 124
Dial indicator:	1 687 233 011
Inserter and extractor for stud bolts:	comm. avail.

Continue: I09/1

TESTERS, FIXTURES, TOOLS

Torque wrench (0...70 Nm):	comm. avail.
Spring balance (0...160 N):	comm. avail.
Torquemeter (0.15...0.80 Nm):	0 986 617 206 (KDAL 5485)
(33...300 Nm):	0 986 617 166 (KDAL 5476)
Clamping support:	0 986 619 362 (KDAW 9999)

Continue: I09/2

TESTERS, FIXTURES, TOOLS

Assembly wrench:	0 986 617 198 (KDAL 5483)
Extractor for needle bushing in armature:	0 986 617 233 (KDAL 5492)
Spring collet 18.1 mm for needle bushing in armature:	0 986 617 240 (KDAL5492/0/7)
Pressing-in mandrel for needle bushing in armature:	0 986 617 185 (KDAL 5479)
Pressing-out and pressing-in mandrel for bushing in commutator end shield:	0 986 617 190 (KDAL 5481)

Continue: I10/1

TESTERS, FIXTURES, TOOLS

Pressing-out and pressing-in tool for bushing and cylindrical roller bearing in drive end bearing: 0 986 617 101 (KDAL 5003)

Sleeve for supporting multi-plate clutch when testing overload protection: 0 986 617 164 (KDAL 5474)

Clamping sleeve for holding armature in three-jaw chuck: 0 986 617 232 (KDAL 5491)

Continue: I10/2

TESTERS, FIXTURES, TOOLS

Thrust piece for holding armature on commutator saw: 0 986 617 224 (KDAL 5489)

Pole-shoe screwdriver: 0 986 619 393 (KDAW 9999/7)

Torx T50 bit insert with hexagon 5/16": comm. avail.

Driving-in mandrel diameter: 84,50 - 0,05 mm (improvisation)

Continue: I01/1

TEST SPECIFICATIONS AND SETTINGS

Commutator minimum diameter:	47,5 mm
Brush contact force:	20...22 N
Armature axial play:	0,2...0,6 mm
Clutch-nut axial play:	0,9...1,8 mm
Initial force of helical spring on engaging shaft:	35...45 N
Final force of helical spring on engaging shaft:	60...70 N

Continue: I11/2

TEST SPECIFICATIONS AND SETTINGS

Eccentricity	
- Commutator:	max. 0,03 mm
- Laminated core:	max. 0,05 mm
New carbon-brush dimension	
- Type A 76 (new version):	18,8 mm
- Type N 42 (old version):	26,5 mm
Minimum carbon-brush dimension	
- Type A 76 (new version):	10,0 mm
- Type N 42 (old version):	16,5 mm

Continue: I12/1

TEST SPECIFICATIONS AND SETTINGS

Multi-plate clutch		
Response torque of overload protection:	170...200	Nm
Overrunning torque:	0,2...0,4	Nm
Resistance, shunt winding		
(24 V/5.4 kW):	960...1060	mOhm
(24 V/6.6 kW):	750... 830	mOhm
(12 V/3.5 kW):	240... 270	mOhm
(12 V/3.6 kW):	220... 250	mOhm
(12 V/4.0 kW):	160... 190	mOhm

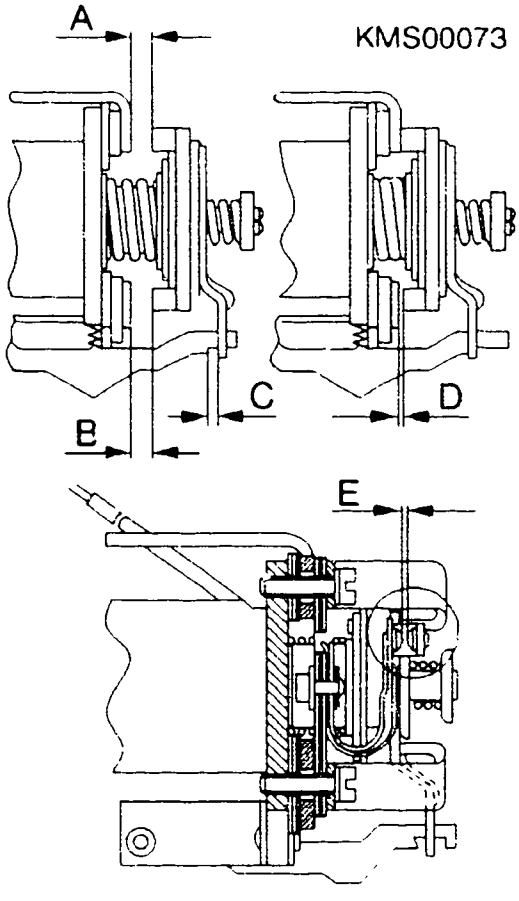
Continue: I13/1

TEST SPECIFICATIONS AND SETTINGS

Test specifications and settings for control relay 0 331 101 ...

Dimensions A and B:	min. 2,0 mm
Dimension C:	min. 0,5 mm
Dimension D:	0,8...1,4 mm
Dimension E:	min. 0,8 mm

Continue: I01/1 Fig.: I13/2



TIGHTENING TORQUES

Pinion attachment:	38...43	Nm
Intermediate-bearing attachment:	7...8,5	Nm
Stud-bolt attachment:	7...8,8	Nm
Commutator end shield attachment:	7,8...9,7	Nm
Control-relay attachment:	11...16	Nm
Starting-motor solenoid attachment:	9,8...14	Nm
Pole-shoe screws:	41...51	Nm
Terminal 30 (M10):	16...20	Nm
Term. 30 (M10 only .334):	14...16	Nm
Terminal 30 (M12):	25...31	Nm
Terminal 31 (M10):	16...20	Nm
Term. 31 (M10 only .334):	14...16	Nm
Terminal 31 (M12):	25...31	Nm
Terminal 50 (M6):	3,5...4,5	Nm

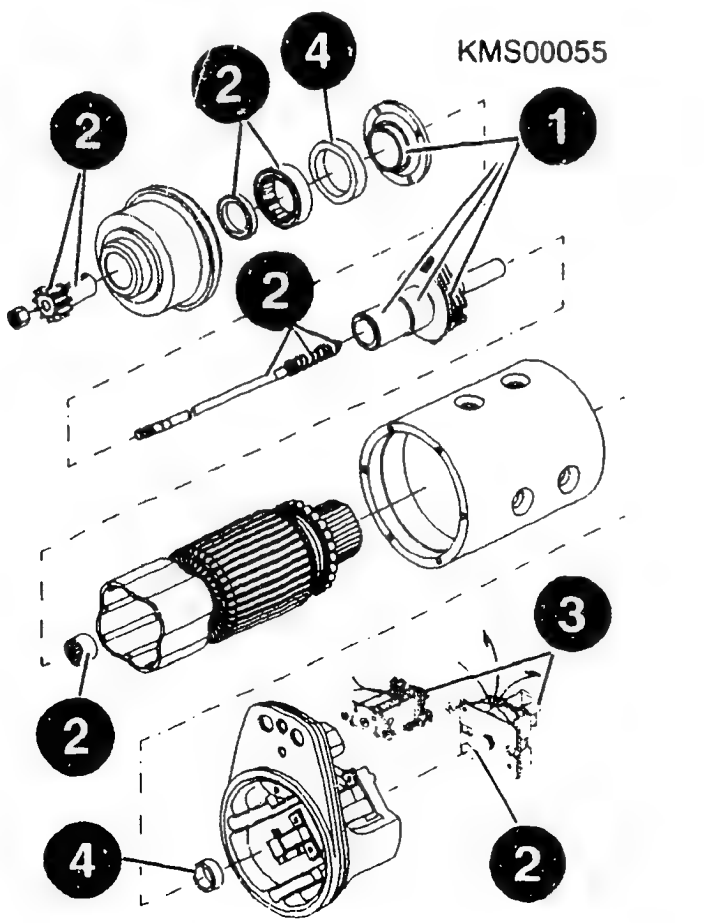
Continue: I01/1

LUBRICANTS/LUBRICATION CHART

General:
Commutator and carbon brushes are to be kept free of grease and oil.
Greased parts are to be degreased before relubricating them.

(1):	Ft2 v 1	5 700 080 000
(2):	Grease VS 10832	5 932 240 000
(3):	Gleitmo 1580V	5 996 328 000
(4):	Shell Tellus oil	comm. avail.

Continue: I01/1 Fig.: I15/2



ELECTRICAL CONNECTIONS AND CIRCUIT DIAGRAMS

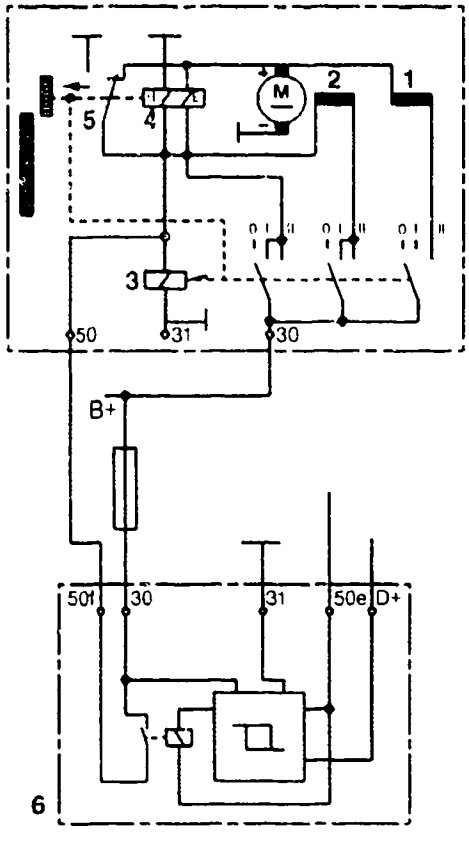
Starting motors with shunt-field switch and ground return

1 = Excitation winding
2 = Shunt winding
3 = Control relay
4 = Starting-motor solenoid
5 = Shunt-field switch
6 = Start-locking and start-repeating relay

I = Shunt winding in series with armature (as auxiliary excitation winding)
II = Shunt winding in parallel with armature (as speed limitation)

Continue: I17/1 Fig.: I16/2

KMS00056



ELECTRICAL CONNECTIONS AND CIRCUIT DIAGRAMS

Starting motors with shunt-field switch and insulated return

1 = Excitation winding
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I = Shunt winding in series with armature (as auxiliary excitation winding)
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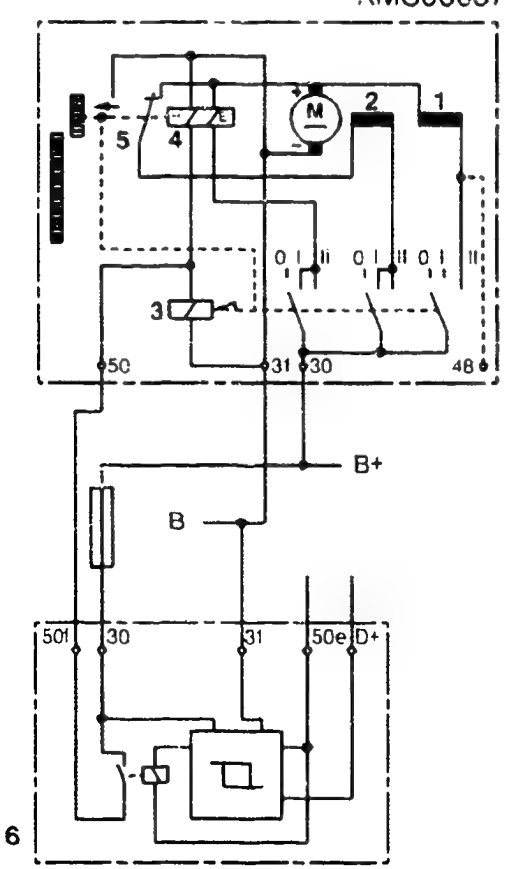
Continue: I01/1 Fig.: I17/2

KMS00057



STARTING-MOTOR DISASSEMBLY TABLE

Continue: I01/1

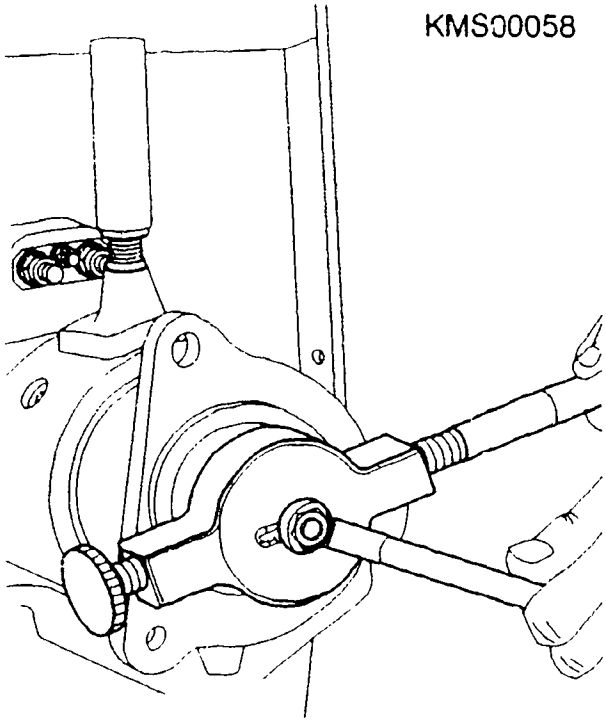
STARTING-MOTOR DISASSEMBLY

Disassembling pinion

Clamp starting motor in clamping support. Loosen Unistop pinion-fastening nut. Counterhold with assembly wrench.
Remove pinion.

Clamping support:	0 986 619 362
Assembly wrench:	0 986 617 198

Continue: I20/1 Fig.: I19/2



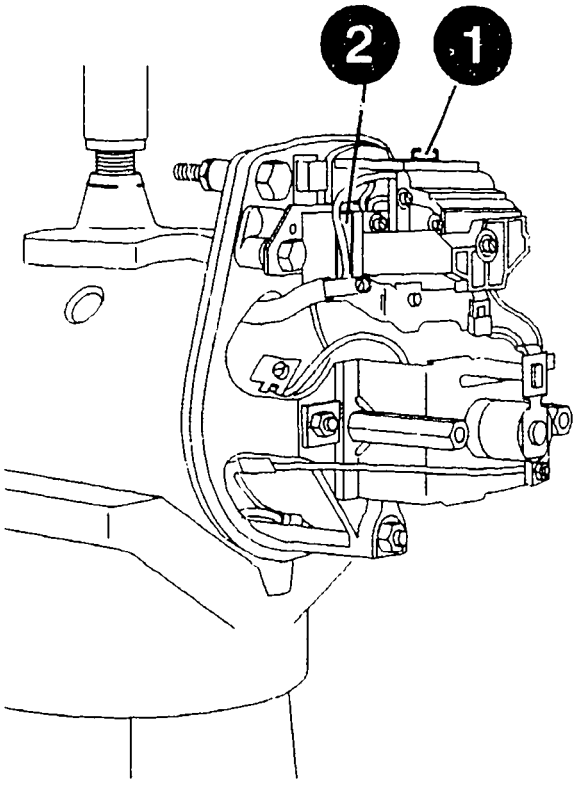
STARTING-MOTOR DISASSEMBLY

Disassembling control relay and starting-motor solenoid

Remove protective cap.
Loosen term. 30/31/50.
Lift off insulating cap (1) and loosen fastening screw.
Unfasten all screw and plug connections at control relay and starting-motor solenoid.
Attention: Fixed cable connection (2) is only to be detached when replacing control relay/starting-motor solenoid.
Detach connections at carbon brushes.

Continue: I21/1 Fig.: I20/2

KMS00059



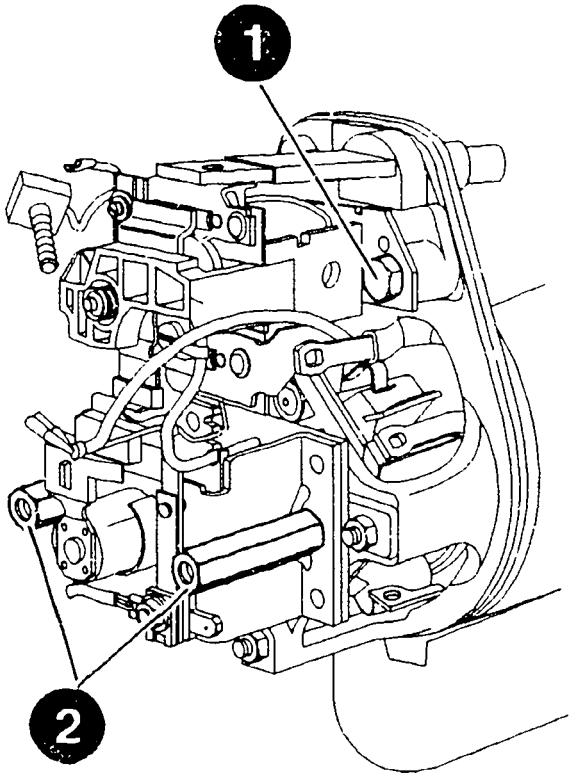
STARTING-MOTOR DISASSEMBLY

Disassembling control relay and starting-motor solenoid

Remove term. 31, connecting bar term. 30 and insulators. Pay attention to O-rings and seal.
Loosen fastening screws (1) at control relay and securing bolt (2) at starting-motor solenoid.
Remove control relay and starting-motor solenoid together with term. 50.
ATTENTION: DANGER OF INJURY
Engaging shaft is spring-pretensioned and shoots out of the armature on disassembling the starting-motor solenoid.

Continue: I22/1 Fig.: I21/2

KMS00060



STARTING-MOTOR DISASSEMBLY

Disassembling carbon brushes

Mark installation position of carbon brushes.
Use suitable tool to lift springs and remove carbon brushes.

Continue: I23/1

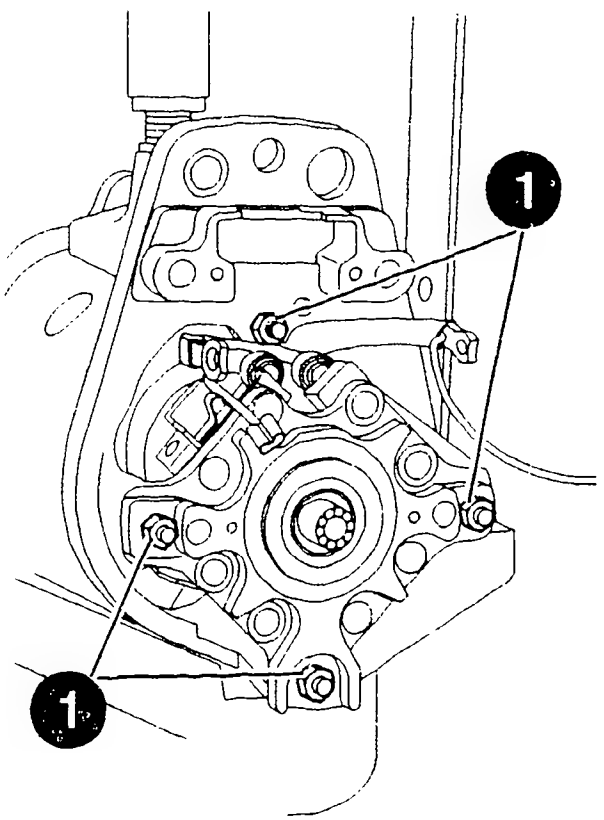
STARTING-MOTOR DISASSEMBLY

Disassembling commutator end shield

Mark position of end shield.
Loosen fastening nuts (1) and pull off commutator end shield.
Take care not to damage insulation of protruding winding ends (bend slightly if necessary).
Pay attention to shims on commutator end of armature shaft.

Continue: I24/1 Fig.: I23/2

KMS00061



STARTING-MOTOR DISASSEMBLY

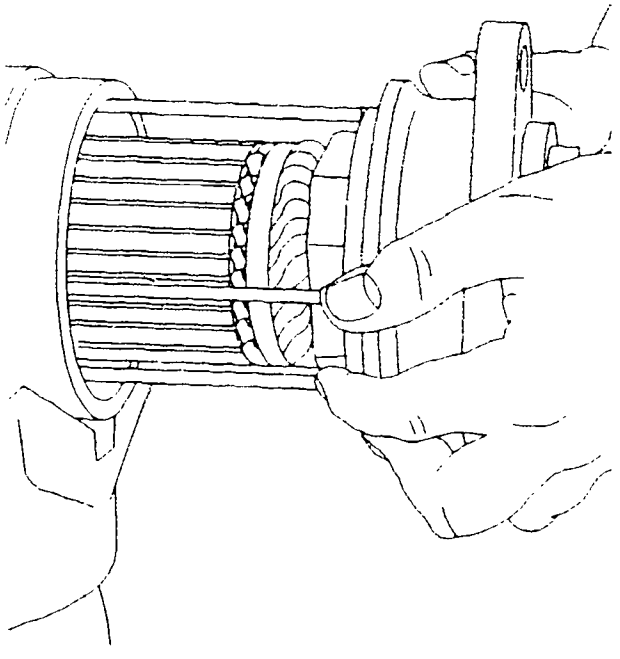
Disassembling drive-end bearing

Mark position of drive-end bearing.
Pull drive-end bearing complete with armature and stud bolts out of stator frame.
Make sure stud bolts do not damage field windings.
Pull armature out of drive-end bearing.
Pay attention to thrust washer.
Mark installation position of short stud bolt in drive-end bearing and use inserter and extractor tc disassemble stud bolts.

Inserter and extractor: comm. avail.

Continue: I25/1 Fig.: I24/2

KMS00062



STARTING-MOTOR DISASSEMBLY

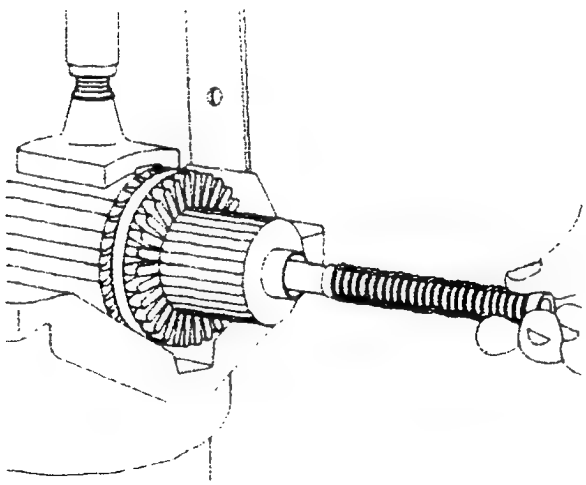
Disassembling engaging shaft

Clamp armature in clamping support.
Pull engaging shaft on commutator end out of armature.

Clamping support: 0 986 619 362

Continue: I26/1 Fig.: I25/2

KMS00063



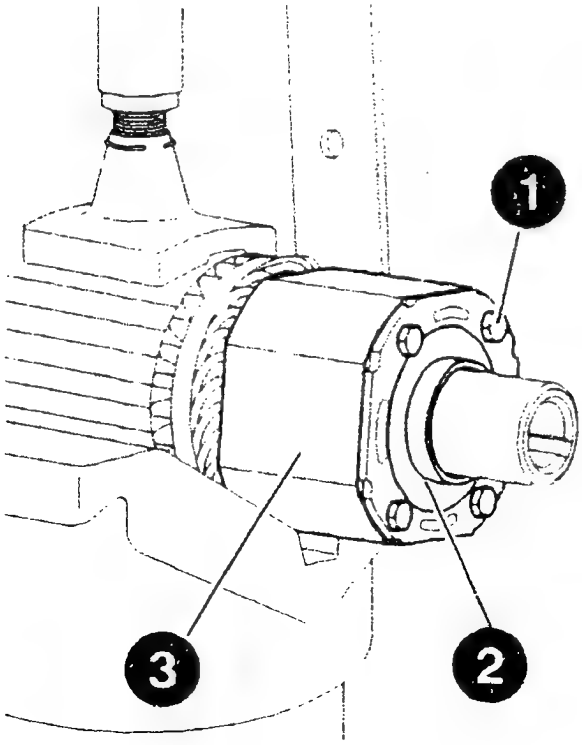
STARTING-MOTOR DISASSEMBLY

Disassembling multi-plate clutch

Loosen fastening screws (1) of intermediate bearing (2).
Remove intermediate bearing from clutch housing (3).

Continue: I27/1 Fig.: I26/2

KMS00064



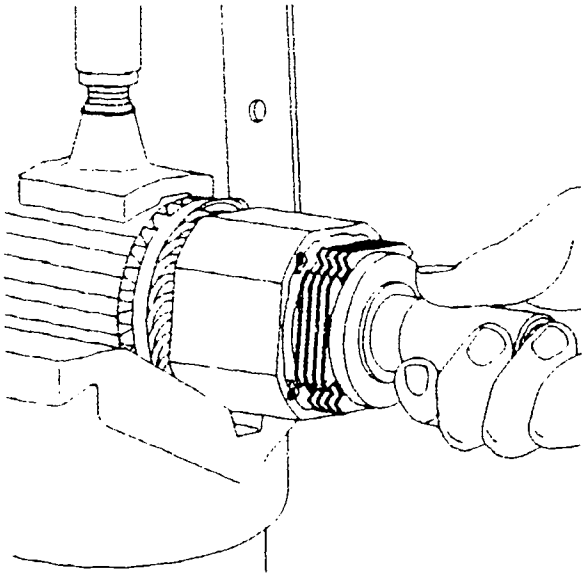
STARTING-MOTOR DISASSEMBLY

Disassembling multi-plate clutch

Pull complete multi-plate clutch out of clutch housing.

Continue: I01/1 Fig.: I27/2

KMS00065



CLEANING OF COMPONENTS

Component cleaning:
Only use compressed air (max. 4 bar) and a clean rag to clean armatures, excitation windings, commutator end shields, relays and the shaft ends of the multi-plate clutch. Do not use cleaning fluids.

Other parts, such as intermediate bearings and drive-end bearings, can be washed out in commercially available cleaners which are not readily flammable.
Take care not to inhale vapors.

Continue: I28/2

CLEANING OF COMPONENTS

Danger of fire: Avoid naked flames, light and sparks.

ATTENTION:
Thoroughly dry cleaned components, as gases may subsequently form in the sealed starting motor and cause an explosion.

Continue: II01/1

CLEANING OF COMPONENTS

Pay attention to the following safety regulations:

* Order governing work with flammable liquids (VbF) as issued by the German Ministry of Labor (BmA).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for handling chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  as issued by the Main Association for Professional Liability Insurance Associations (Central Association for Accident Prevention and Industrial Medicine), Langwartweg 103, 53129 Bonn.

Continue: II01/2

CLEANING OF COMPONENTS

Outside Germany, pay attention to the appropriate local regulations.

Continue: I01/1

CHECKING, REPAIR TABLE

Continue: II02/2

CHECKING, REPAIR TABLE

Continue: I01/1

CHECKING AND REPAIRING COMPONENTS

Checking pinion

Check pinion for running marks and chipping.
Replace if necessary.

Continue: II04/1

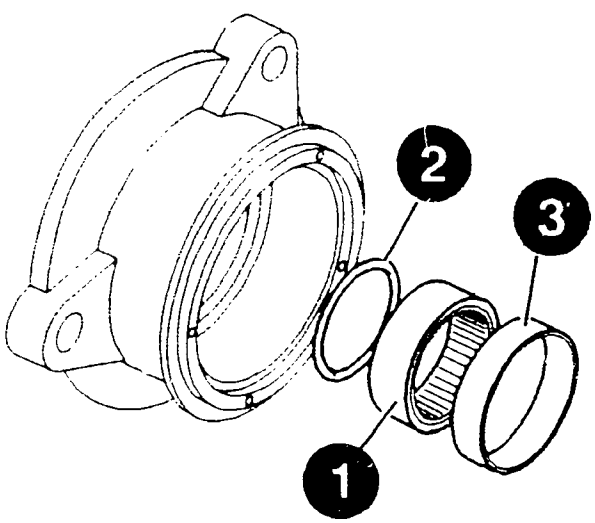
CHECKING AND REPAIRING COMPONENTS

Checking drive-end bearing

Cylindrical roller bearing (1), radial lip-type oil seal (2) and bushing (3) must always be renewed.

Continue: II05/1 Fig.: II04/2

KMS00066



CHECKING AND REPAIRING COMPONENTS

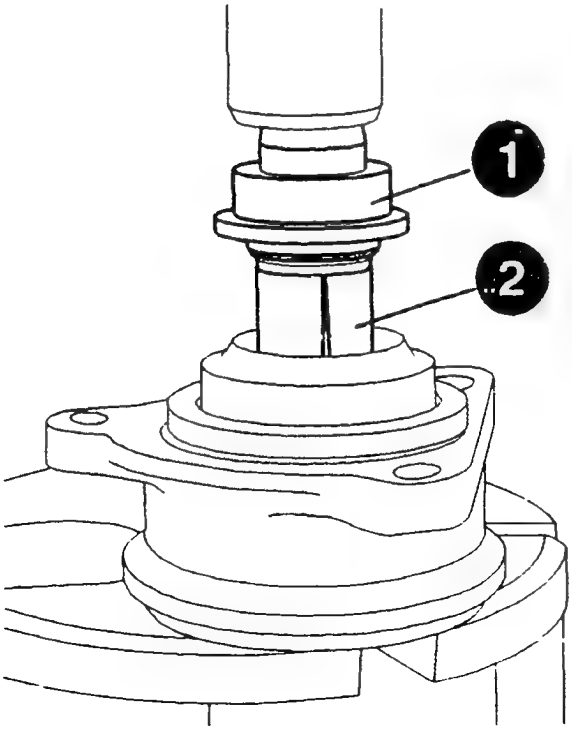
Checking drive-end bearing

Removal: Use pressing-out and pressing-in tool (1) to press out cylindrical roller bearing together with bushing. The gripping edges of the two jaws (2) must be inserted between radial lip-type oil seal and cylindrical roller bearing.
Remove radial lip-type oil seal.

Pressing-out and pressing-in tool for bushing and cylindrical roller bearing in drive-end bearing: 0 986 617 101

Continue: II06/1 Fig.: II05/2

KMS00067



CHECKING AND REPAIRING COMPONENTS

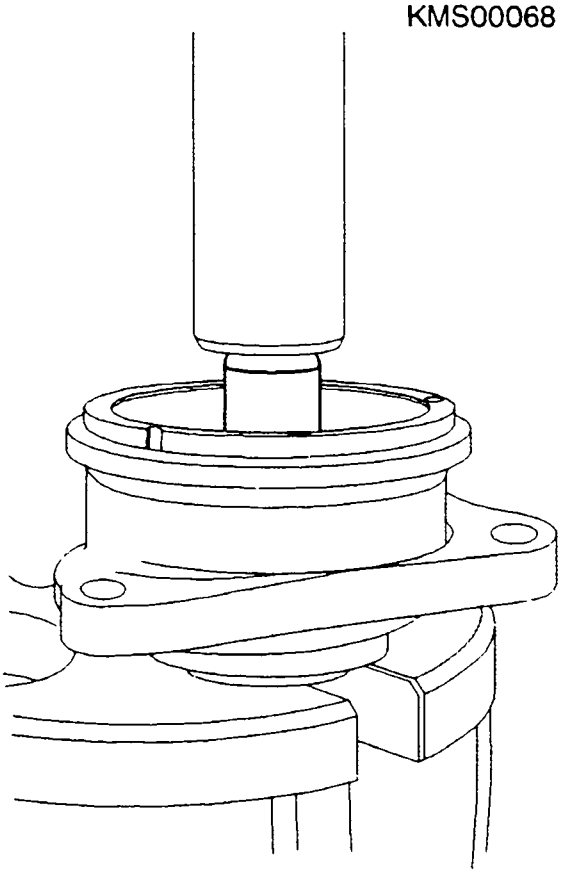
Checking drive-end bearing

Installation: Insert radial lip-type oil seal in drive-end bearing. Use reversed pressing-out and pressing-in tool to press in cylindrical roller bearing and then bushing. Grease bearing.

Pressing-out and pressing-in tool for bushing and cylindrical roller bearing in drive-end bearing:	0 986 617 101
Grease VS 10832:	5 932 240 000

Continue: II07/1 Fig.: II06/2

KMS00068



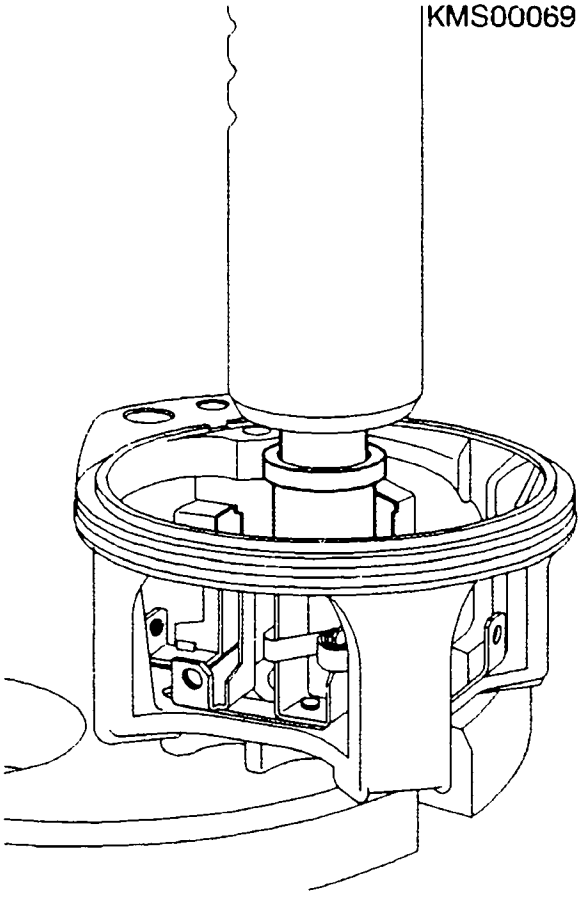
CHECKING AND REPAIRING COMPONENTS

Checking commutator end shield

Check bushing for damage and running marks.
Removal:
Use pressing-out and pressing-in mandrel to press out bushing.

Pressing-out and pressing-in mandrel for bushing in commutator end shield: 0 986 617 190

Continue: II08/1 Fig.: II07/2



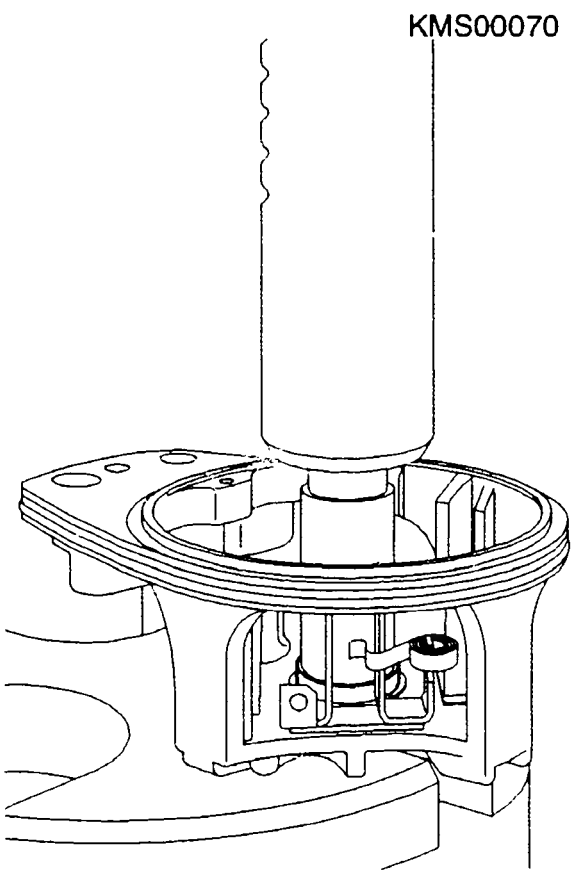
CHECKING AND REPAIRING COMPONENTS

Checking commutator end shield

Installation: Use reversed pressing-out and pressing-in mandrel to press in new bushing.
ATTENTION: Bushing must have been impregnated beforehand for 8 hours with Shell Tellus oil.

Pressing-out and pressing-in mandrel for bushing in commutator end shield:	0 986 617 190
Shell Tellus oil:	comm. avail.

Continue: II09/1 Fig.: II08/2



CHECKING AND REPAIRING COMPONENTS

Checking commutator end shield

Check all carbon-brush holders insulated against commutator end shield for ground short.
("+" carbon-brush holders/insulated
"-" carbon-brush holders)

Interturn short-circuit tester	0 986 619 110
Test prods	0 986 619 114

Ground-short test voltage: 80 V

Continue: II10/1

CHECKING AND REPAIRING COMPONENTS

Checking carbon brushes

Check tightness of connections.
Check bearing surfaces for scoring and chipping. Replace carbon brushes if minimum dimension has been reached.

New carbon-brush dimension	
- Type A 76 (new version):	18,8 mm
- Type N 42 (old version):	26,5 mm
Minimum carbon-brush dimension	
- Type A 76 (new version):	10,0 mm
- Type N 42 (old version):	16,5 mm

Continue: II11/1

CHECKING AND REPAIRING COMPONENTS

Checking control relay and starting-motor solenoid

Check tight ground connection of control relay and starting-motor solenoid. Ground connection must be bonded on with vibration-proof versions.
Individual components cannot be replaced. Replace scorched or damaged control relays and solenoids.
Always use the service parts given in the replacement parts list.

Continue: II1 1/2

CHECKING AND REPAIRING COMPONENTS

Only starting-motor solenoids with shunt-field switch are now to be fitted.
When installing control relay 0 331 101 ... in starting motor with long excitation-winding ends, these must be shortened by 7 mm by bending to form a loop.

Continue: II12/1

CHECKING AND REPAIRING COMPONENTS

Checking control relay and starting-motor solenoid

In the case of starting motors produced prior to date of manufacture FD 461, the old, incompletely insulated version of terminals 30 and 50 must be converted to the new, thermoplast-encapsulated type.
A distinction is to be made between two different situations:

Continue: II12/2

CHECKING AND REPAIRING COMPONENTS

For starting motors with M 12 thread at connection term. 30 perform conversion using:
- Parts set tm. 30,31 (2 007 011 069)
- Parts set tm. 50 (2 007 011 070)
- Connecting bar tm. 30

For starting motors with M 10 thread at connection term. 30 perform conversion using:
- Parts set tm. 30,31 (2 007 011 069)
- Parts set tm. 50 (2 007 011 070)
- Connecting bar tm. 30
- New commutator end shield

Continue: II13/1

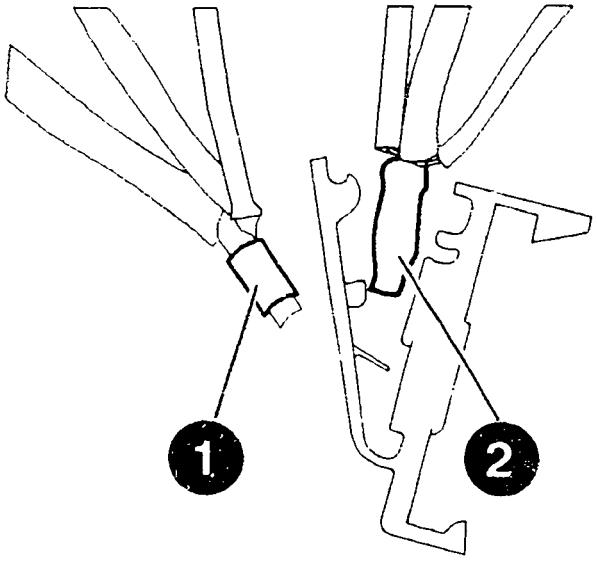
CHECKING AND REPAIRING COMPONENTS

Checking control relay and starting-motor solenoid

When installing insulated term. 50, electrical connection to control relay and holding winding of starting-motor solenoid must be re-established as follows:
Strip approx. 10 mm of cable.
Insert all three cables in end splice (1), press together slightly and solder on.
Pull shrinkdown tubing (2) over end splice (ends of cables must not protrude out of shrinkdown tubing).

Continue: II14/1 Fig.: II13/2

KMS00071



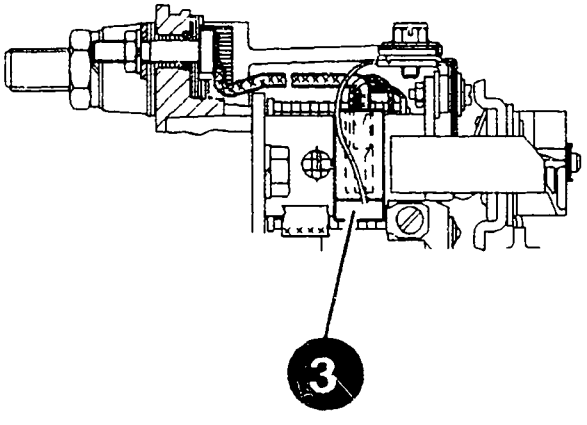
CHECKING AND REPAIRING COMPONENTS

Checking control relay and starting-motor solenoid

Fit new clip (3) (disposable) at control relay. Clip must be seated in groove in strap of control relay. Insert insulated end splice into clip at control relay as far as it will go and squeeze clip together.

Continue: II15/1 Fig.: II14/2

KMS00072



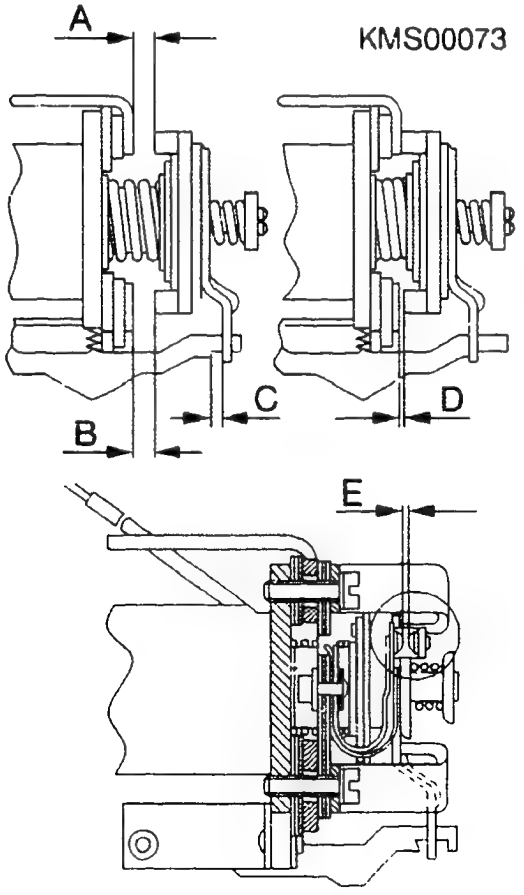
CHECKING AND REPAIRING COMPONENTS

Checking control relay and starting-motor solenoid

Control relay deenergized
Dimensions A and B: min. 2,0 mm

Locking and release lever in rest position, locking lever slightly applied
Dimension C: min. 0,5 mm

Continue: II16/1 Fig.: II15/2



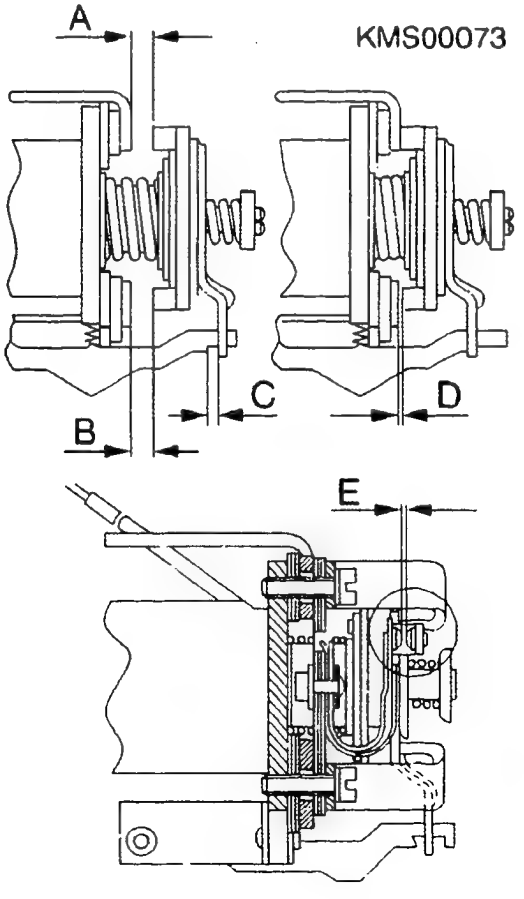
CHECKING AND REPAIRING COMPONENTS

Checking control relay and starting-motor solenoid

Armature retracted, release lever in locked position
Dimension D: 0,8...1,4 mm

Auxiliary contacts, control relay deenergized
Dimension E: min. 0,8 mm

Continue: II17/1 Fig.: II16/2



CHECKING AND REPAIRING COMPONENTS

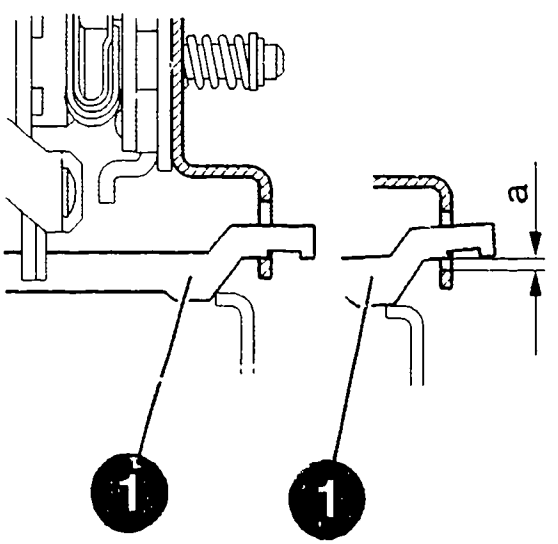
Adjusting control relay and starting-motor solenoid

Clean all contacts with contact file.

Check on wear reserve
Release lever (1) (catch) and latching lever of control relay in end position (primary current):
Dimension a: 2,0...3,0 mm

Continue: II18/1 Fig.: II17/2

KMS00075

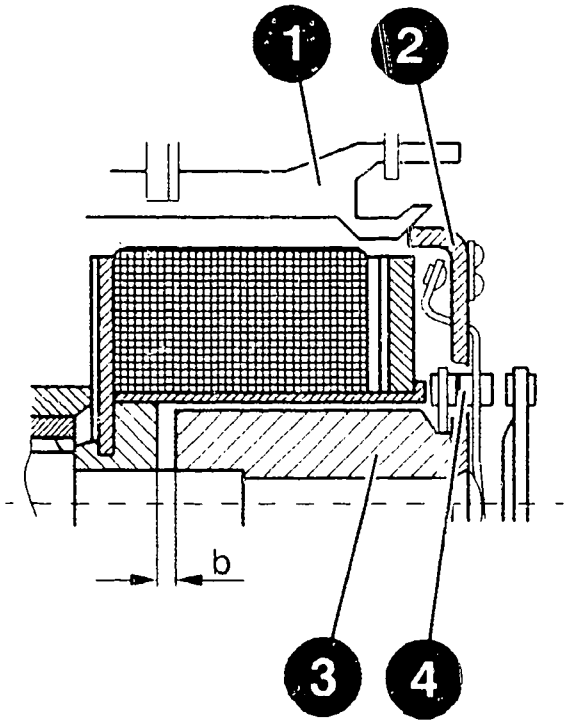


Adjusting control relay and starting-motor solenoid

Actuator lever (2) of solenoid in release position (contact with release lever (1)). Remaining travel of armature (3):
Dimension b: 1,0...2,0 mm
Bend actuator lever (2) if necessary.
Pay attenti to riveted joint.
N/O contact of shunt-field switch (4) must close 0,6...1,2 mm before end of stroke.

Continue: II19/1 Fig.: II18/2

KMS00076



CHECKING AND REPAIRING COMPONENTS

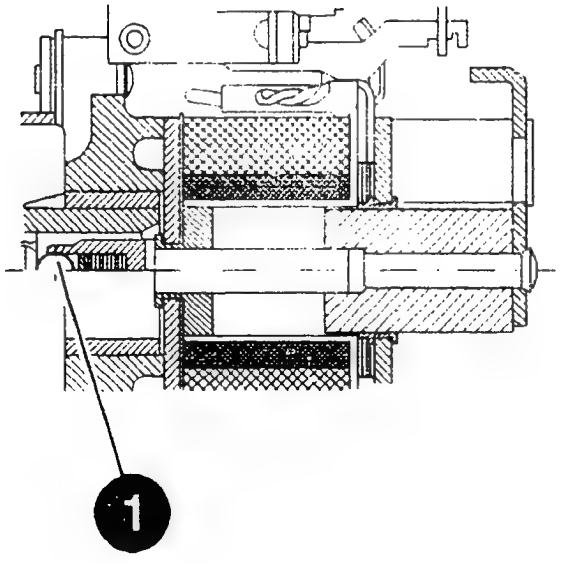
Checking return force of helical spring on engaging shaft

This is performed with starting-motor assembled.
It must be possible to push pinion back into rest position with spring action via rubber buffer in thrust piece of starting-motor solenoid.
Engaging shaft must be seated on ball (1) in starting-motor solenoid in rest position.

Initial force:	35...45 N
Final force:	60...70 N

Continue: II20/1 Fig.: II19/2

KMS00077



CHECKING AND REPAIRING COMPONENTS

Checking multi-plate clutch

If the value for the axial play of the clutch nut, the overrunning torque or the response torque of the overload protection is outside the stated range, the entire multi-plate clutch must be replaced.

Axial play:	0,9...1,8 mm
Overrunning torque:	0,2...0,4 Nm
Response torque, overload protection:	170...200 Nm

Continue: II21/1

CHECKING AND REPAIRING COMPONENTS

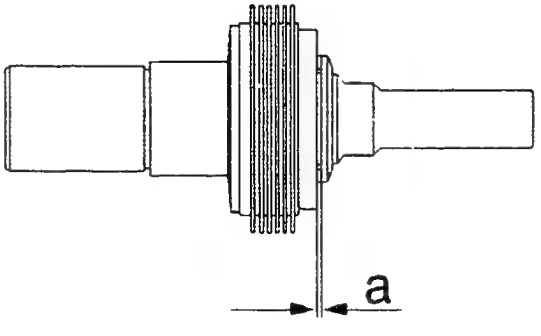
Checking multi-plate clutch

Check axial play of clutch nut.

Dimension a: 0,9...1,8 mm

Continue: II22/1 Fig.: II21/2

KMS00151



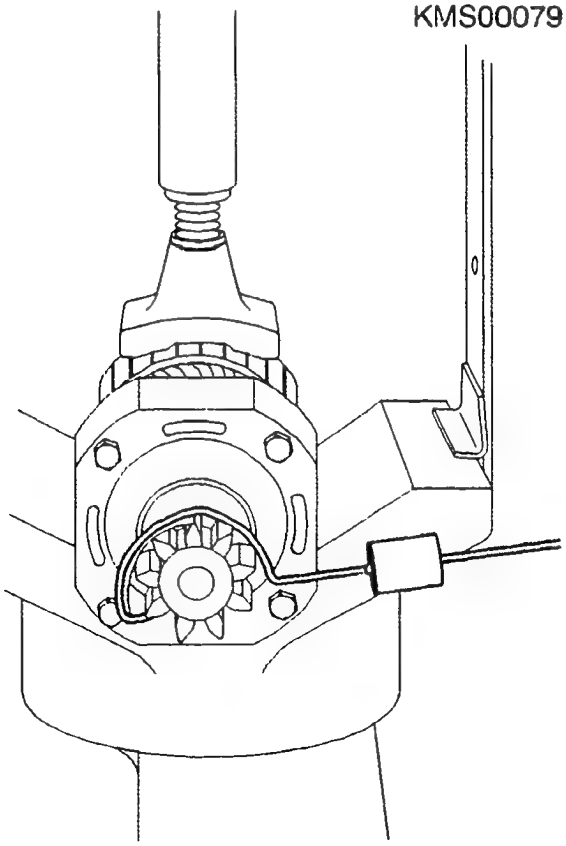
CHECKING AND REPAIRING COMPONENTS

Checking multi-plate clutch

Check overrunning torque of clutch.
Clamp armature with clutch fitted in clamping support.
Insert pinion in drive spindle.
Check overrunning torque of multi-plate clutch with torquemeter in non-friction direction.

Torquemeter:	0 986 617 206
Overrunning torque:	0,2...0,4 Nm

Continue: II23/1 Fig.: II22/2



CHECKING AND REPAIRING COMPONENTS

Checking multi-plate clutch

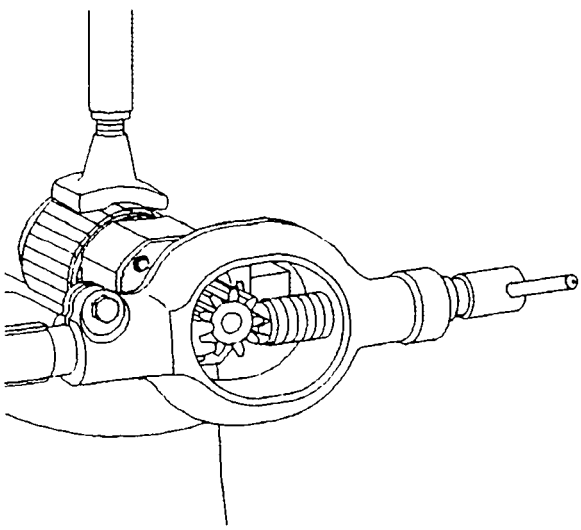
Check clutch overload protection.
Slip support sleeve over drive spindle into intermdiate bearing and insert pinion in drive spindle.
Use torquemeter to check response torque in friction direction.

Torquemeter:	0 986 617 166
Support sleeve:	0 986 617 164

Response torque, overload protection:	170...200 Nm

Continue: II24/1 Fig.: II23/2

KMS00080



CHECKING AND REPAIRING COMPONENTS

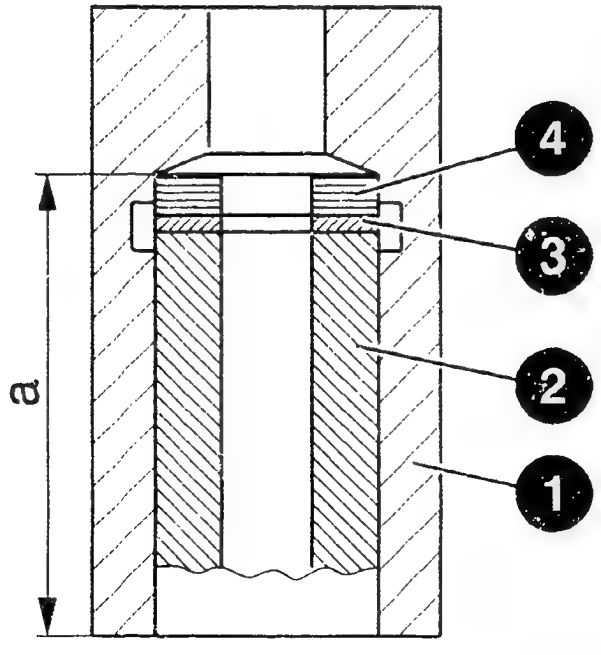
Checking drilling depth with extended drive spindle

The drilling depth has to be checked on starting motors with extended drive spindle (shaft length approx. 80 mm).
Dimension a: 44,0...44,6 mm
If necessary, fit shim between rubber bushing and pinion shaft.

1 = Drive spindle
2 = Pinion shaft
3 = Shim 3 100 100 000
4 = Rubber bushing

Continue: II25/1 Fig.: II24/2

KMS00081

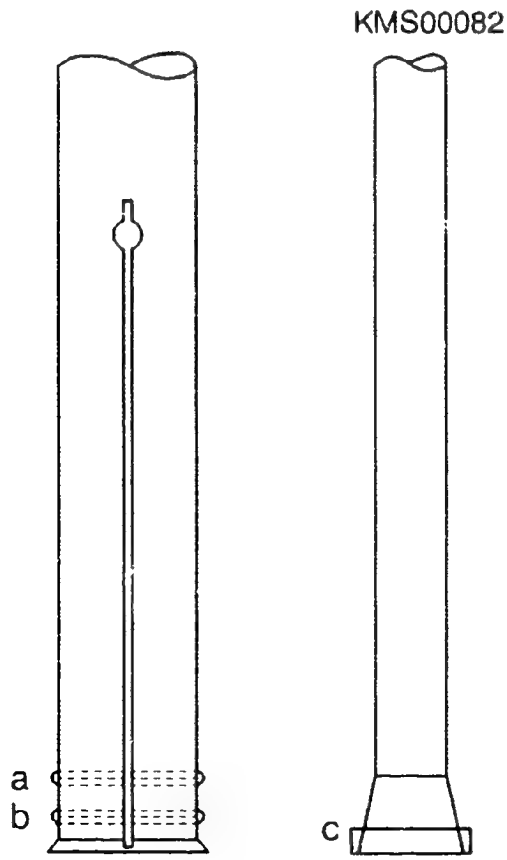


CHECKING AND REPAIRING COMPONENTS

Checking needle bushing in armature

Only replace needle bushing if bearing surface of bushing on drive spindle shows signs of wear, running-in or seizure marks, scoring or temperature-induced discoloration.
The two annular lugs "a" and "b" have to be ground off at the spring collet before extracting the needle bushing.
The limit stop "c" at the cone of the extractor must be tapered.

Continue: II26/1 Fig.: II25/2



CHECKING AND REPAIRING COMPONENTS

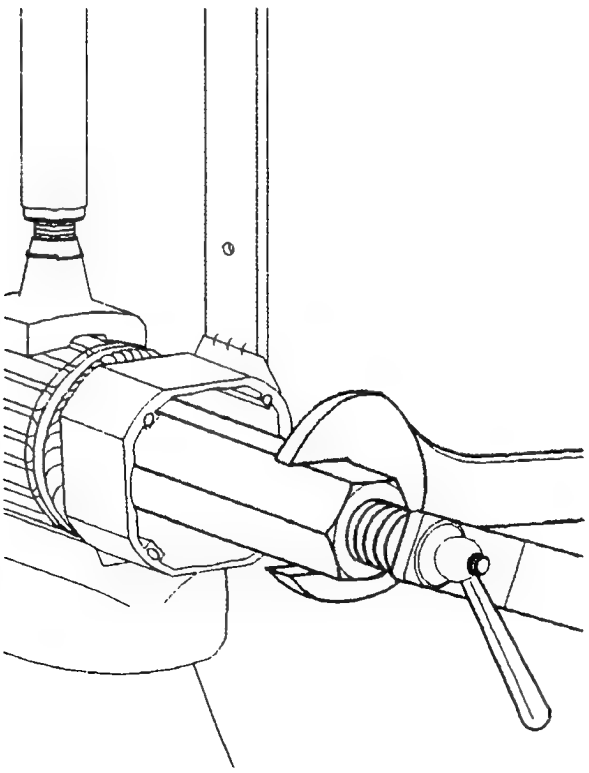
Replacing needle bushing in armature

Removal:
Clamp armature in clamping support.
Use extractor to pull out needle bushing.

Clamping support:	0 986 619 362
Extractor for needle bushing in armature:	0 986 617 233
Spring collet 18.1 mm for needle bushing in armature	0 986 617 240

Continue: II27/1 Fig.: II26/2

KMS00083

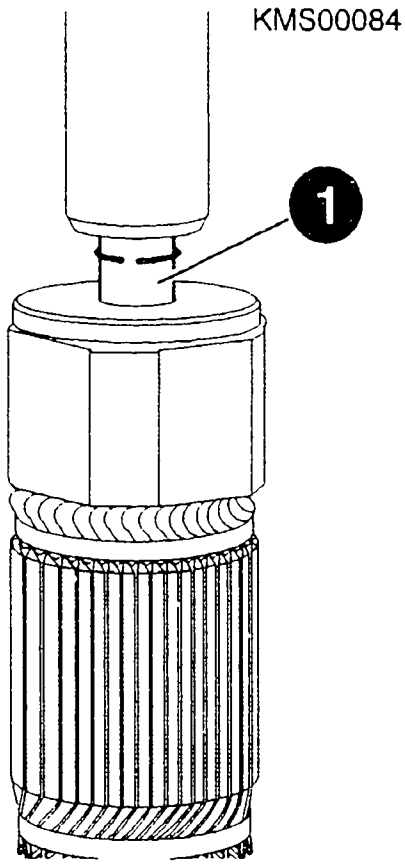


Replacing needle bushing in armature

Installation: Grease needle bushing before pressing it in.
Use pressing-in mandrel (1) to press needle bushing into armature such that needle bushing designation can be seen from outside.

Pressing-in mandrel for needle bushing in armature:	0 986 617 185
Grease VS 10832:	5 932 240 000

Continue: II28/1 Fig.: II27/2



CHECKING AND REPAIRING COMPONENTS

Checking armature for interturn short circuit, ground short and continuity

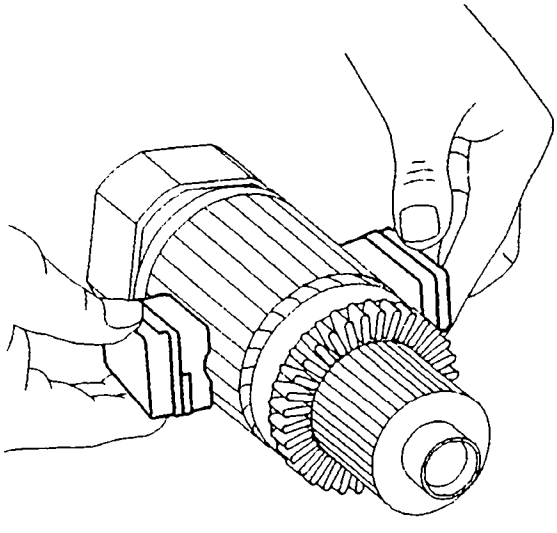
Check for interturn short circuit with tester and test probes. Check for ground short and continuity with tester and test prods.

Interturn short circuit tester:	0 986 619 110
Test prods:	0 986 619 114

Ground short test voltage: 80 V
Continuity test voltage: 40 V

Continue: III01/1 Fig.: II28/2

KMS00085



CHECKING AND REPAIRING COMPONENTS

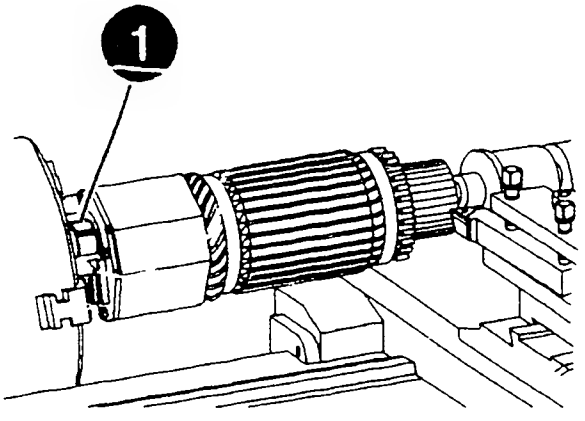
Checking commutator

Check commutator concentricity and turn down if necessary. Note minimum diameter.
To turn down, fit intermediate bearing and mount armature in three-jaw chuck using clamping sleeve (1).

Clamping sleeve:	0 986 617 232
Minimum diameter:	47,50 mm
Eccentricity	
- Commutator:	max. 0,03 mm
- Laminated core:	max. 0,05 mm

Continue: III02/1 Fig.: III01/2

KMS00086



CHECKING AND REPAIRING COMPONENTS

Checking commutator

ATTENTION: On starting motors produced prior to date of manufacture FD 461 the lamination insulation of the commutator contains asbestos.
Use suitable extraction unit when working. The insulation is asbestos-free on starting motors as of FD 461.

The lamination insulation of the commutator must be sawn out after turning down with a suitable tool.

Continue: III02/2

CHECKING AND REPAIRING COMPONENTS

If commutator saw is employed, use must be made of a suitable extraction unit and the thrust piece for holding the armature.
Turn down commutator again after sawing out and check for interturn short circuit and ground short.
Note diameter.

Thrust piece:	0 986 617 224
Interturn short circuit tester:	0 986 619 110
Test prods:	0 986 619 114

Minimum diameter:	47,5 mm
Ground short test voltage:	80 V

Continue: III03/1

CHECKING AND REPAIRING COMPONENTS

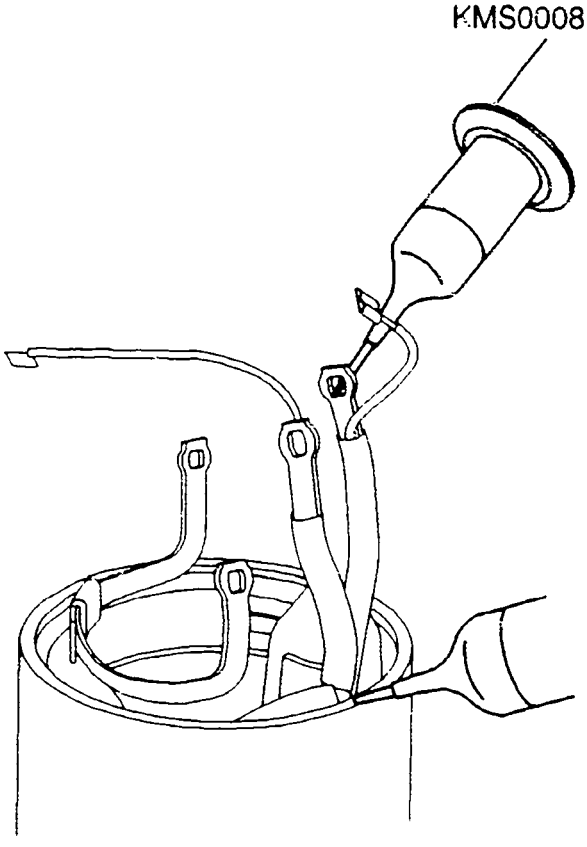
Checking excitation winding

Check each winding for ground short and continuity using tester and test prods.

Interturn short circuit tester:	0 986 619 110
Test prods:	0 986 619 114

Ground short test voltage: 80 V
Continuity test voltage: 40 V

Continue: III04/1 Fig.: III03/2



CHECKING AND REPAIRING COMPONENTS

Checking excitation winding

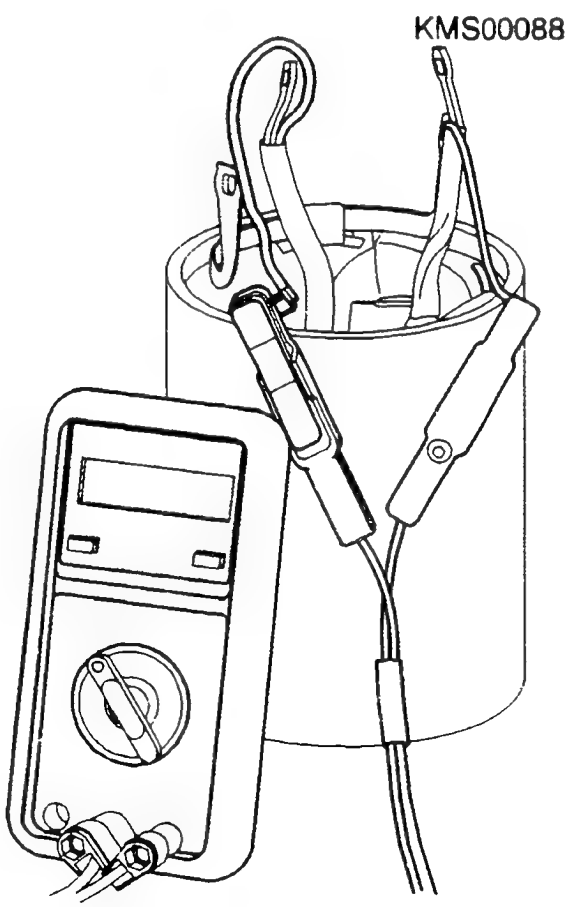
Use tester to check resistance values.

Alternator tester: 0 684 201 200
(or Motortester)

Resistance, shunt winding
(24 V/5.4 kW): 960...1060 mOhm
(24 V/6.6 kW): 750... 830 mOhm

(12 V/3.5 kW): 240... 270 mOhm
(12 V/3.6 kW): 220... 250 mOhm
(12 V/4.0 kW): 160... 190 mOhm

Continue: III05/1 Fig.: III04/2



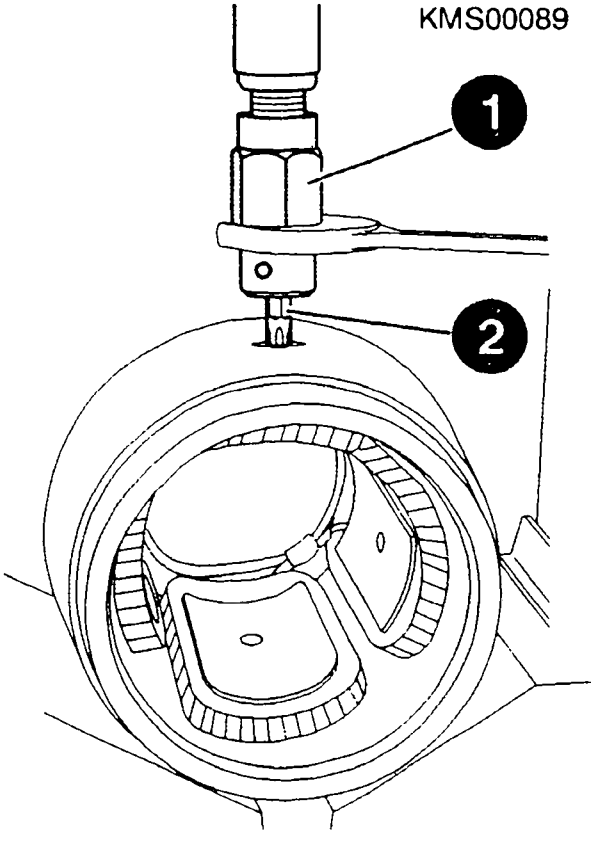
CHECKING AND REPAIRING COMPONENTS

Replacing excitation winding

Replace damaged, scorched or unsoldered windings.
Removal: Place stator frame in clamping support. Mark position of pole shoes. Loosen screws with pole-shoe screwdriver (1) and Torx insert (2). Remove pole shoes and windings.

Pole-shoe screwdriver:	0 986 619 393
Torx T50 bit insert with hexagon 5/16":	comm. avail.

Continue: III06/1 Fig.: III05/2

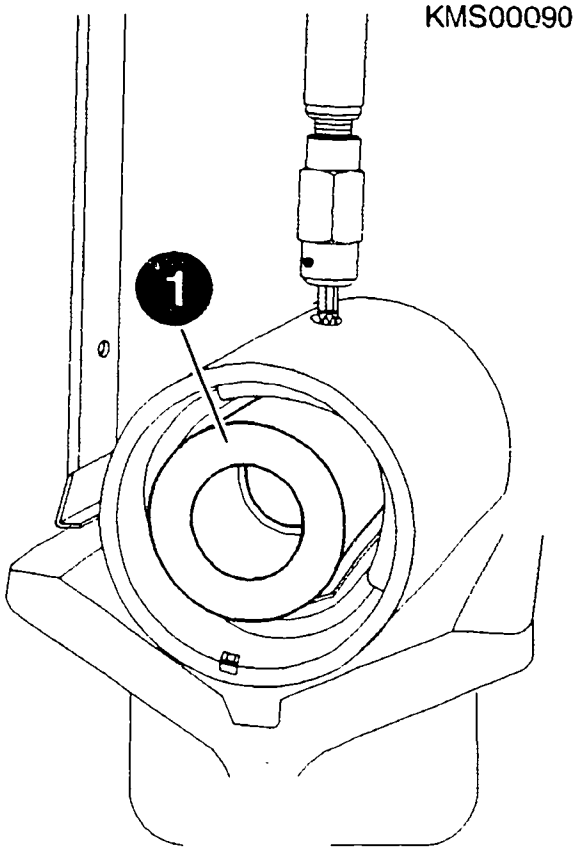


Replacing excitation winding

Installation: Warm excitation windings before fitting, insert with pole shoes in stator frame and slightly tighten screws.
Pay attention to markings.
Press in driving-in mandrel (1).

Driving-in mandrel diameter:	84,50-0,05 mm (improvisation)

Continue: III07/1 Fig.: III06/2



CHECKING AND REPAIRING COMPONENTS

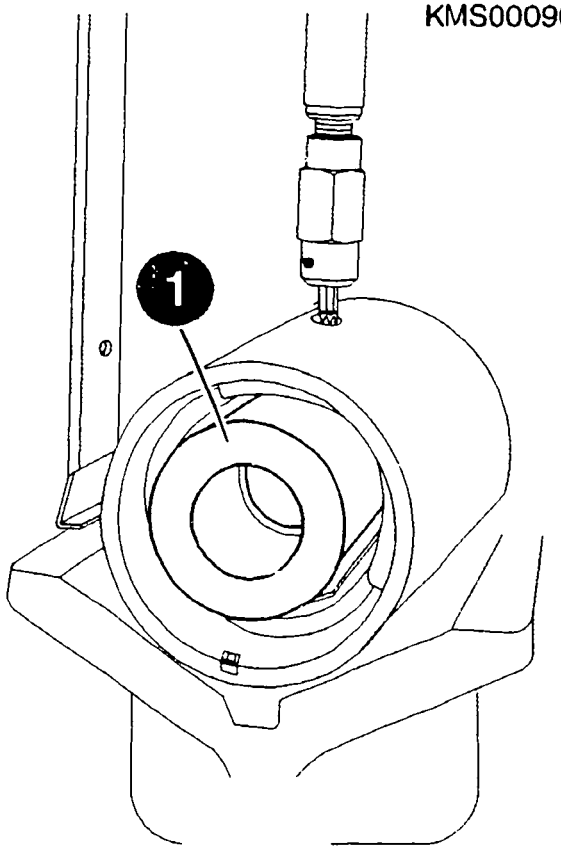
Replacing excitation winding

Place stator frame in clamping support.
Finish-tightening pole-shoe screws
and press out driving-in mandrel (1).

Pole-shoe screwdriver:	0 986 619 393
Torx T50 bit insert with hexagon 5/16":	comm. avail.

Tightening torque Pole-shoe screws:	41...51 Nm

Continue: III08/1 Fig.: III07/2



CHECKING AND REPAIRING COMPONENTS

Replacing excitation winding

If an excitation winding with short winding ends is installed in a starting motor with control relay 0 331 100 ... the relay must be replaced with the new version (0 331 101 ...).

Continue: I01/1

CONVERSION/REPAIR OF BUSBAR

KB starting motors as of date of manufacture FD 461 feature the following quality enhancement:
The busbar term. 30 and stud term. 50 are insulated on the inside of the starting motors by way of thermoplast encapsulation. Starting motors prior to FD 461 with the old non-insulated version for terms. 30 and 50 must be converted to the new thermoplast-encapsulated version.

Continue: III09/2

CONVERSION/REPAIR OF BUSBAR

A distinction is to be made between the following two situations when converting starting motors prior to FD 461:
For starting motors with M 12 thread at connection term. 30 perform conversion using:
- Parts set tm. 30,31 (2 007 011 069)
- Parts set tm. 50 (2 007 011 070)
- Connecting bar tm. 30

For starting motors with M 10 thread at connection term. 30 perform conversion using:
- Parts set tm. 30,31 (2 007 011 069)
- Parts set tm. 50 (2 007 011 070)
- Connecting bar tm. 30
- New commutator end shield

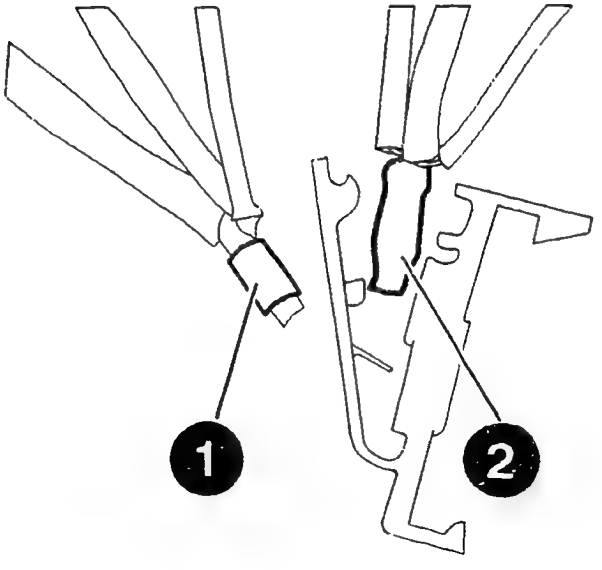
Continue: III10/1

CONVERSION/REPAIR OF BUSBAR

When installing insulated term. 50, electrical connection to control relay and holding winding of starting-motor solenoid must be re-established as follows:
Strip approx. 10 mm of cable.
Insert all three cables in end splice (1), press together slightly and solder on.
Pull shrinkdown tubing (2) over end splice (ends of cables must not protrude out of shrinkdown tubing).

Continue: III11/1 Fig.: III10/2

KMS00071

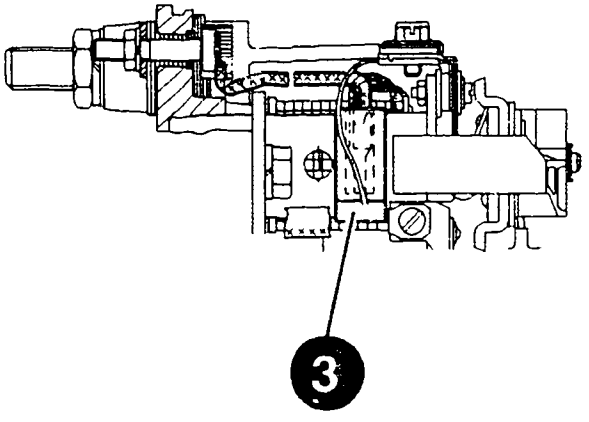


CONVERSION/REPAIR OF BUSBAR

Fit new clip (3) (disposable) at control relay. Clip must be seated in groove in strap of control relay. Insert insulated end splice into clip at control relay as far as it will go and squeeze clip together.

Continue: I01/1 Fig.: III1l/2

KMS00072



STARTING-MOTOR ASSEMBLY TABLE

Continue: I01/1

STARTING-MOTOR ASSEMBLY

Assembling multi-plate clutch

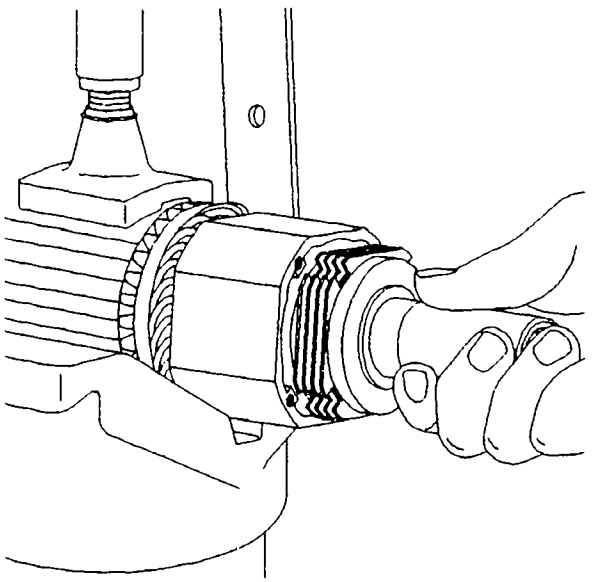
Lubricate as per lubrication chart before and during assembly.

Clamp armature in clamping support. Insert multi-plate clutch in clutch housing.

Clamping support: 0 986 619 362

Continue: III14/1 Fig.: III13/2

KMS00065



STARTING-MOTOR ASSEMBLY

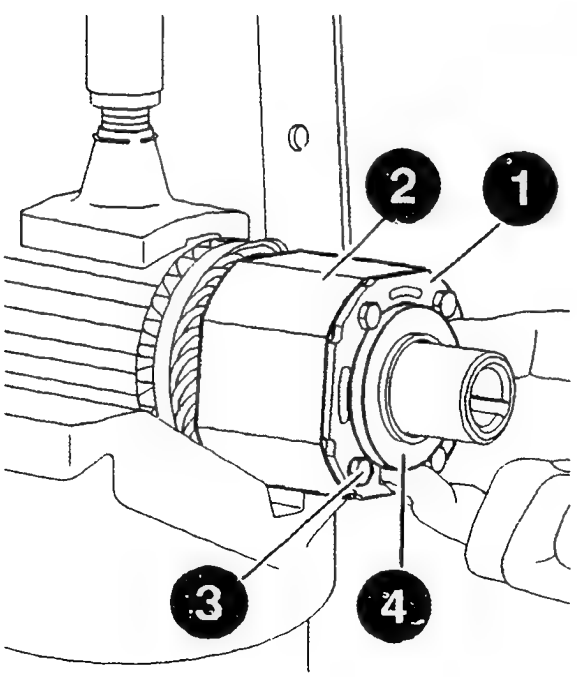
Assembling multi-plate clutch

Screw intermediate bearing (1) to clutch housing (2).
Always use new, microencapsulated hexagon bolts (3) of strength class 10.9.
Use torque wrench.
Slip thrust washer (4) onto intermediate bearing.

Torque wrench:	comm. avail.
Tightening torque:	7...8,5 Nm

Continue: III15/1 Fig.: III14/2

KMS00091



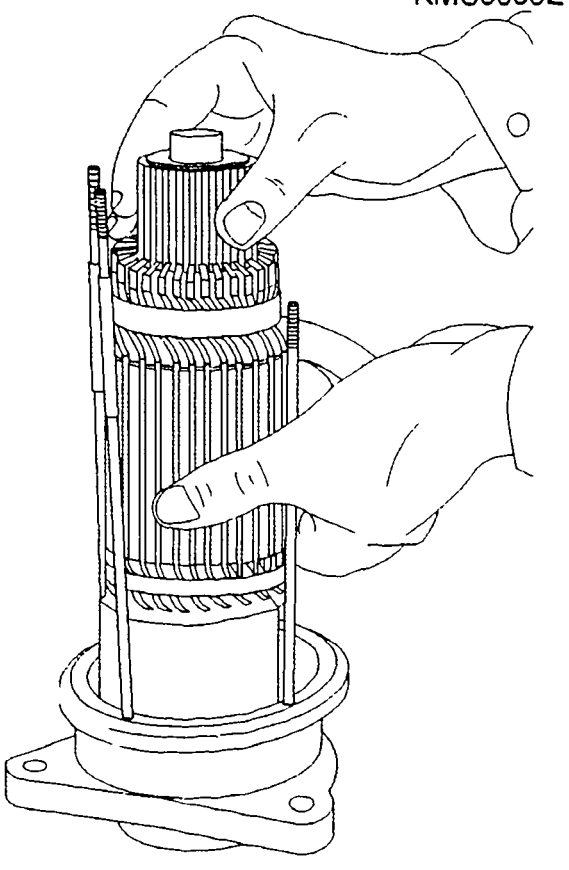
STARTING-MOTOR ASSEMBLY

Assembling drive-end bearing

Screw stud bolts with short thread end and collar into drive-end bearing.
Pay attention to installation position mark of short stud bolt.
Insert armature in drive-end bearing.

Continue: III16/1 Fig.: III15/2

KMS00092



STARTING-MOTOR ASSEMBLY

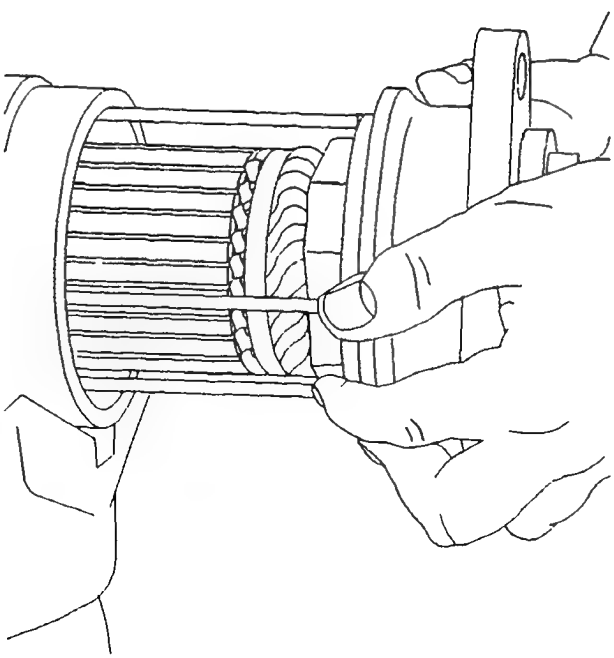
Assembling drive-end bearing

Clamp stator frame in clamping support.
Carefully insert drive-end bearing complete with armature in stator frame.
Pay attention to marking.
The stud bolts must not damage the field windings.

Clamping support: 0 986 619 362

Continue: III17/1 Fig.: III16/2

KMS00062



STARTING-MOTOR ASSEMBLY

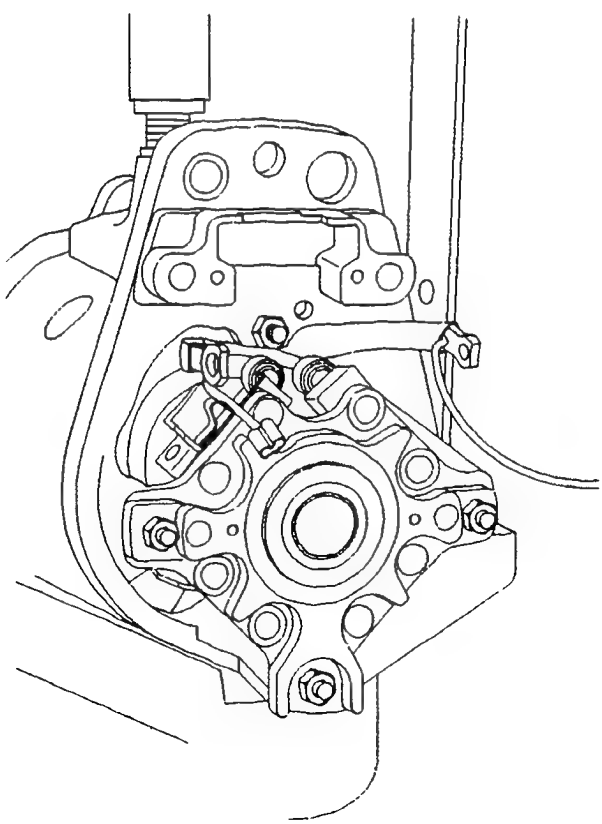
Assembling commutator end shield

Slip shims onto commutator end of armature shaft.
Assemble commutator end shield.
Pay attention to marking.
Use torque wrench.
When assembling end shield, take care not to damage insulation of protruding winding ends (bend slightly if necessary).

Torque wrench:	comm. avail.
Tightening torque:	7...8,8 Nm

Continue: III18/1 Fig.: III17/2

KMS00093



STARTING-MOTOR ASSEMBLY

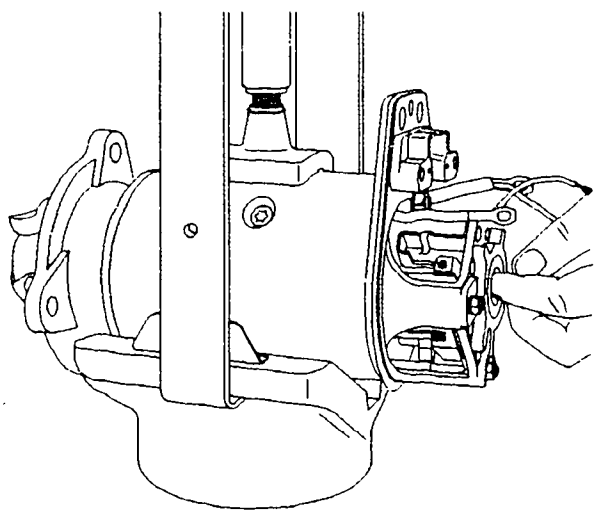
Checking armature axial play

Adjust armature axial play on commutator end only by way of shims.
Check freedom of movement of armature.

Armature axial play: 0,2...0,6 mm

Continue: III19/1 Fig.: III18/2

KMS00094



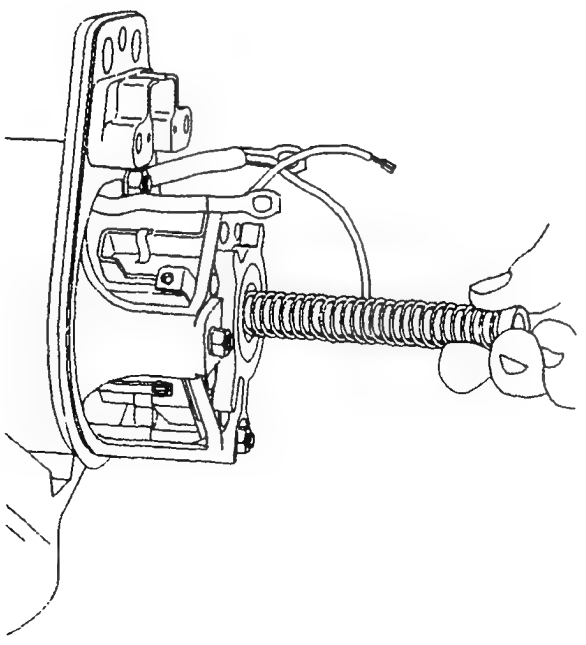
STARTING-MOTOR ASSEMBLY

Assembling engaging shaft

Insert engaging shaft from commutator end into armature until serrations of engaging shaft mesh with those of drive spindle.
If necessary, turn drive spindle at drive end.

Continue: III20/1 Fig.: III19/2

KMS00095



STARTING-MOTOR ASSEMBLY

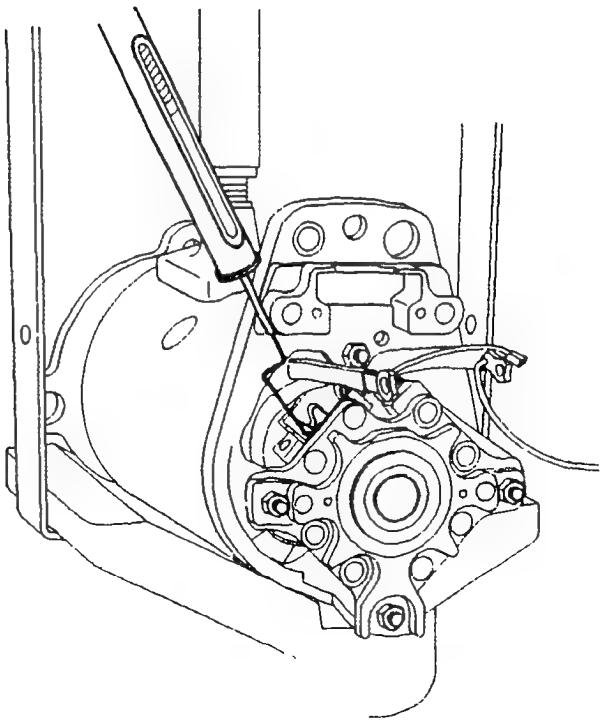
Assembling carbon brushes

Use suitable tool to lift springs and insert carbon brushes. Pay attention to installation position mark.
Use spring balance to check brush contact force.

Spring balance (0...160 N):	comm. avail.
Brush contact force:	20...22 N

Continue: III21/1 Fig.: III20/2

KMS00096



STARTING-MOTOR ASSEMBLY

Assembling control relay and starting-motor solenoid

Fit control relay and starting-motor solenoid. Use torque wrench.
ATTENTION: DANGER OF INJURY
Engaging shaft is spring-pretensioned and shoots out of armature on removing starting-motor solenoid.

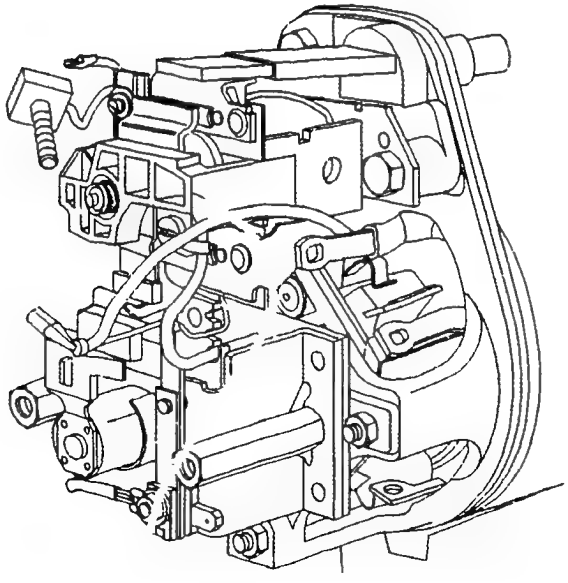
Torque wrench:	comm. avail.

Tightening torque

Hexagon bolts:	11...16 Nm
Securing bolts:	9,8...14 Nm

Continue: III22/1 Fig.: III21/2

KMS00097



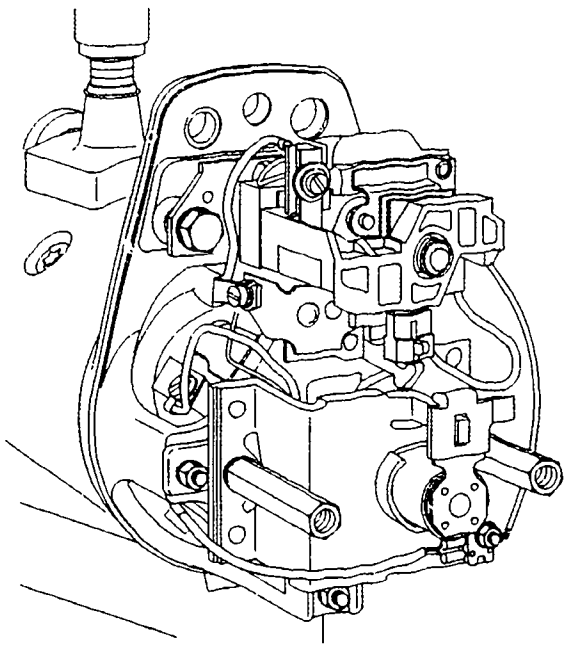
STARTING-MOTOR ASSEMBLY

Assembling control relay and starting-motor solenoid

Make all electrical connections as per terminal diagram at control relay and starting-motor solenoid. Ends of field winding must lie flat on connections of control relay.
Bend slightly if necessary.
Secure carbon-brush connections.
Pay attention to different screw lengths.

Continue: III23/1 Fig.: III22/2

KMS00098



STARTING-MOTOR ASSEMBLY

Assembling term. 30/31/50

Insert connecting bar term. 30 and stud term. 50 in insulating plate with seal.
Slip O-rings over stud term. 30/50 and insert in commutator end shield.
Slip O-ring over stud term. 31 and insert in commutator end shield.
Ensure proper fit of seal and O-rings.
Slip sleeve over term. 31.

Continue: III23/2

STARTING-MOTOR ASSEMBLY

Attach insulator, washers, spring lock washers and hexagon nuts.
Attach connecting bar term. 30 to control relay and fit insulating cap.

Tightening torque

Terminal 30 (M10):	16...20 Nm
Term. 30 (M10 only ...334):	14...16 Nm
Terminal 30 (M12):	25...31 Nm
Terminal 31 (M10):	16...20 Nm
Term. 31 (M10 only ...334):	14...16 Nm
Terminal 31 (M12):	25...31 Nm
Terminal 48 (M5):	2,6...3,5 Nm
Terminal 50 (M6):	3,5...4,5 Nm

Continue: III24/1

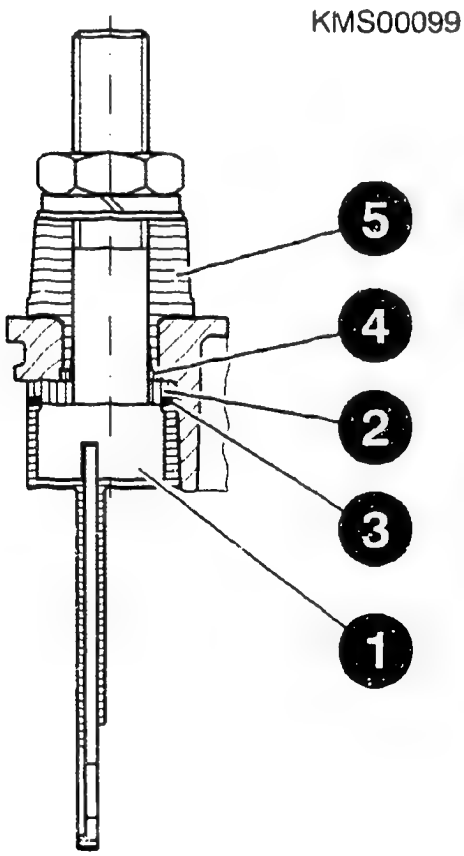
STARTING-MOTOR ASSEMBLY

Assembling term. 30/31/50

Terminal 30:

1 = Connecting bar term. 30
2 = Inner insulating plate
3 = Seal
4 = O-ring
5 = Outer insulator

Continue: III25/1 Fig.: III24/2



STARTING-MOTOR ASSEMBLY

Assembling term. 30/31/50

Terminal 31:
6 = Stud term. 31
4 = O-ring
5 = Outer insulator
7 = Sleeve

Continue: III26/1 Fig.: III25/2

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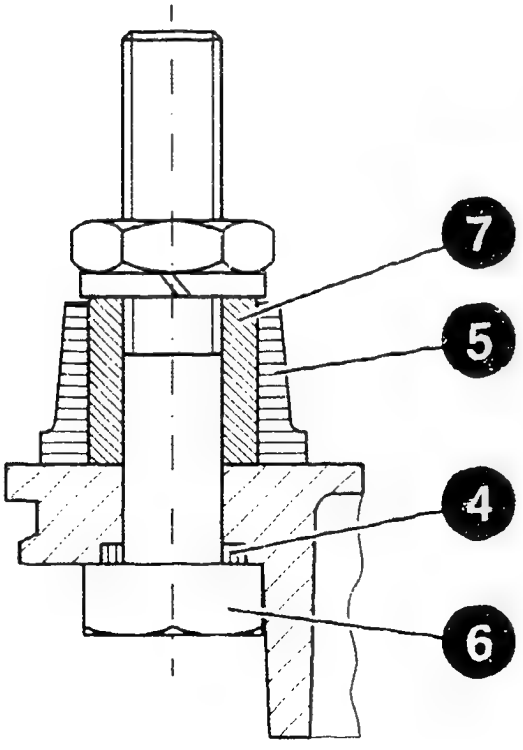

STARTING-MOTOR ASSEMBLY

Assembling term. 30/31/50

Terminal 50:
8 = Stud term. 50
2 = Inner insulating plate
4 = O-ring
5 = Outer insulator

Continue: III27/1 Fig.: III26/2

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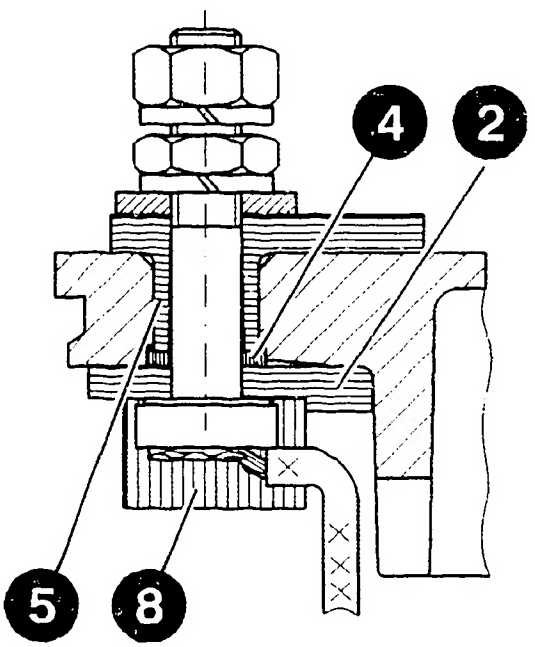


Assembling protective cap

Fit and secure protective cap.
Use new seals for commutator end shield and fastening screws.

Continue: III28/1

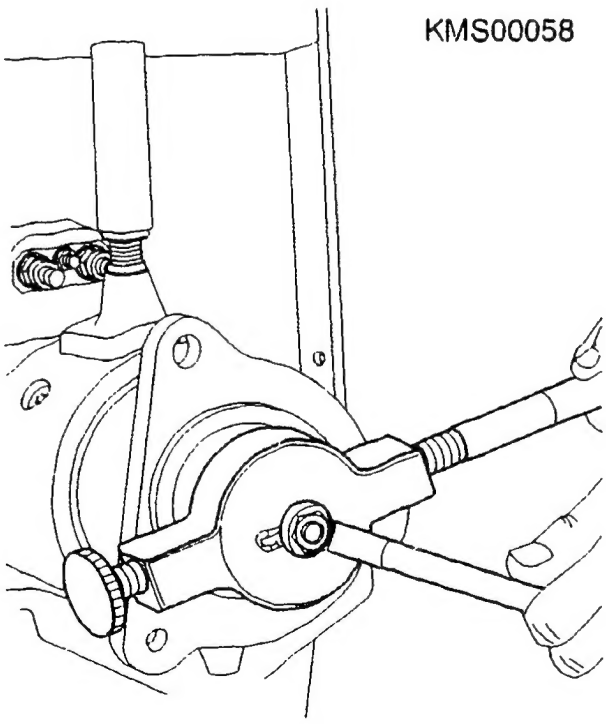
STARTING-MOTOR ASSEMBLY

Assembling pinion

Insert pinion in drive spindle and secure with new Unistop nut.
Use torque wrench.
Counterhold with assembly wrench.

Torque wrench:	comm. avail.
Assembly wrench:	0 986 617 198
Tightening torque:	38...43 Nm

Continue: I01/1 Fig.: III28/2



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Continue: IV01/2

EDITORIAL NOTE

Continue: I01/1